

Applicants: P. Bonutti and J. Hawkins
Application No.: 09/992,211
Examiner: M. Thaler

Amendments to the Claims

1.-56. (canceled)

57. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath having a passage which extends between axially opposite end portions of said sheath, said sheath being resiliently expandable from a contracted condition in which the passage through said sheath has a relatively small cross sectional size in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which the passage through said sheath has a relatively large cross sectional size in a plane perpendicular to the longitudinal central axis of said sheath, said sheath having an oval cross section in a plane extending perpendicular to the longitudinal central axis of said sheath when said sheath is in the contracted condition; and an array of filaments which is enclosed by said sheath and extends axially substantially from one end portion to the other end portion of said sheath, wherein said sheath is biased in the contracted condition.

58. (previously presented) An expandable cannula as set forth in claim 57 wherein said passage in said sheath has an oval cross section in a plane extending perpendicular to the longitudinal central axis of said sheath when said sheath is in the contracted condition.

59. (previously presented) An expandable cannula as set forth in claim 57 wherein said sheath has an oval cross section in a plane extending perpendicular to the longitudinal central axis of said sheath when said sheath is in the expanded condition.

60. (previously presented) An expandable cannula as set forth in claim 59 wherein said passage in said sheath has an oval cross section in a plane extending perpendicular to the longitudinal central axis of said sheath when said sheath is in the expanded condition.

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61. (previously presented) An expandable cannula as set forth in claim 57 wherein said passage in said sheath is engageable by a member having an oval cross sectional configuration in a plane extending perpendicular to the longitudinal central axis of said sheath, said member having an oval cross sectional configuration being axially movable along said passage in said sheath to expand said sheath from the contracted condition to the expanded condition.

62. (previously presented) An expandable cannula as set forth in claim 57 further including pump means connected in fluid communication with said passage in said sheath, said pump means being operable to provide fluid pressure which is applied to said passage in said sheath to expand said sheath from the contracted condition to the expanded condition.

63. (canceled)

64. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath leaving a passage which extends between axially opposite end portions of said sheath, said sheath being resiliently expandable from a contracted condition in which the passage through said sheath has a relatively small cross sectional size in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which the passage through said sheath has a relatively large cross sectional size in a plane perpendicular to the longitudinal central axis of said sheath, said sheath having an oval cross section in a plane extending perpendicular to the longitudinal central axis of said sheath when said sheath is in the contracted condition; and a variable volume chamber connected with said sheath and movable into the patient's body tissue with at least a portion of said sheath, said variable volume chamber being expandable

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under the influence of fluid pressure to an extended condition in which said variable volume chamber projects outward from a side surface of said sheath to retard withdrawal of said sheath from the patient's body tissue.

65. (previously presented) An expandable cannula as set forth in claim 57 wherein said cannula has a pointed end portion for piercing the patient's body tissue when said sheath is in the contracted condition and has an oval cross section in a plane extending perpendicular to the longitudinal central axis of said sheath.

66. (currently amended) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath which at least partially encloses an array of filaments which extends between axially opposite end portions of said sheath substantially from one end portion to the other end portion of said sheath, said sheath having a passage configured and dimensioned to receive an object therethrough and which extends between opposite end portions of said sheath with said array of filaments extending along an inner side of said passage such that said array of filaments blocks contact between an object inserted in the passage and said sheath maintaining the object in a spaced apart, non-contacting relationship with said sheath, said sheath, passage, and array of filaments being resiliently expandable from a contracted condition in which said sheath, ~~passage~~, and array of filaments have a relatively small oval cross sectional size in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which said sheath, ~~passage~~, and array of filaments have a relatively large oval cross sectional size in a plane perpendicular to the longitudinal central axis of said sheath, wherein said sheath is biased inwardly to the contracted condition.

67. (canceled)

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68. (previously presented) An expandable cannula as set forth in claim 66 wherein the passage through the sheath has a relatively small oval cross sectional size in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which the passage through said sheath has a relatively large oval cross sectional size in a plane perpendicular to the longitudinal central axis of said sheath.

69. (canceled)

70. (previously presented) An expandable cannula as set forth in claim 66 wherein said passage in said sheath is engagable by a member having an oval cross sectional configuration in a plane extending perpendicular to a longitudinal central axis of said sheath, said member having an oval cross sectional configuration being axially movable along said passage to expand said sheath and array of filaments from the contracted condition to the expanded condition.

71. (previously presented) An expandable cannula as set forth in claim 66 wherein pump means is connected in fluid communication with said passage in said sheath, said pump means being operable to provide fluid pressure which is applied to said passage in said sheath to expand said sheath and array of filaments from the contracted condition to the expanded condition.

72. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath which at least partially encloses an array of filaments which extends between axially opposite end portions of said sheath, said sheath and said array of filaments being resiliently expandable from a contracted condition in which said sheath and said array of filaments have a relatively small cross sectional size in a plane perpendicular to a longitudinal central axis of said sheath to an

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expanded condition in which said sheath and said array of filaments leave a relatively large cross sectional size in a plane perpendicular to the longitudinal central axis of said sheath; and a variable volume chamber connected with said sheath and insertable into the patient's body tissue with at least a portion of said sheath, said variable volume chamber being expandable under the influence of fluid pressure to an extended condition in which said variable volume chamber projects outward from a side surface of said sheath to retard withdrawal of said sheath from the patient's body tissue.

73. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath which at least partially encloses an array of filaments which extends between axially opposite end portions of said sheath, said sheath and said array of filaments being resiliently expandable from a contracted condition in which said sheath and said array of filaments have a relatively small cross sectional size in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which said sheath and said array of filaments leave a relatively large cross sectional size in a plane perpendicular to the longitudinal central axis of said sheath, wherein said sheath has a pointed end portion for piercing body tissue when said sheath and array of filaments are in the contracted condition.

74. (canceled)

75. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath having a passage which extends between axially opposite end portions of said sheath, said sheath being resiliently expandable from a contracted condition in which said sheath and passage have relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which said sheath and passage have relatively

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large oval cross sectional sizes in a plane perpendicular to the longitudinal central axis of said sheath, and a pointed end portion at least partially formed by said sheath for piercing body tissue when said sheath and passage have the relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath.

76. (canceled)

77. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath which at least partially encloses an array of filaments which extends between axially opposite end portions of said sheath, said sheath having a passage which extends between axially opposite end portions of said sheath, said sheath and said array of filaments being resiliently expandable from a contracted condition in which said sheath, array of filaments, and passage have relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which said sheath, array of filaments, and passage have relatively large oval cross sectional sizes in a plane perpendicular to the longitudinal central axis of said sheath, and a pointed end portion for piercing body tissue when said sheath and passage have the relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath, wherein said passage in said sheath is engagable by a member having an oval cross sectional configuration in a plane extending perpendicular to the longitudinal central axis of said sheath, said member having an oval cross sectional configuration being axially movable along said passage in said sheath to expand said sheath from the contracted condition to the expanded condition.

78. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath having a passage which extends between axially opposite end portions of said sheath, said sheath being resiliently

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expandable from a contracted condition in which said sheath and passage have relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which said sheath and passage have relatively large oval cross sectional sizes in a plane perpendicular to the longitudinal central axis of said sheath, and a pointed end portion for piercing body tissue when said sheath and passage have the relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath; and pump means connected in fluid communication with said passage in said sheath, said pump means being operable to provide fluid pressure which is applied to said passage in said sheath to expand said sheath from the contracted condition to the expanded condition.

79. (previously presented) An expandable cannula which is movable into a patient's body tissue, said cannula comprising a tubular sheath having a passage which extends between axially opposite end portions of said sheath, said sheath being resiliently expandable from a contracted condition in which said sheath and passage have relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath to an expanded condition in which said sheath and passage have relatively large oval cross sectional sizes in a plane perpendicular to the longitudinal central axis of said sheath, and a pointed end portion for piercing body tissue when said sheath and passage have the relatively small oval cross sectional sizes in a plane perpendicular to a longitudinal central axis of said sheath; and a variable volume chamber connected with said sheath and movable into the patient's body tissue with a least a portion of said sheath, said variable volume chamber being expandable under the influence of fluid pressure to an extended condition in which said variable volume chamber projects outward from a side surface of said sheath to retard withdrawal of said sheath from the patient's body tissue.

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80. (previously presented) An expandable cannula as set forth in claim 66 wherein each filament in the array of filaments is made of a flexible, non-stretchable material.

81. (previously presented) An expandable cannula as set forth in claim 66 wherein each filament in the array of filaments has a substantially circular cross section.

82. (canceled)

83. (previously presented) An expandable cannula as set forth in claim 66 wherein the number of filaments in the array of filaments is selected such that the array of filaments blocks contact between the object and the sheath in the expanded condition.

84. (previously presented) An expandable cannula as set forth in claim 66 wherein the sheath biases the array of filaments radially inward.

85. (previously presented) An expandable cannula as set forth in claim 66 further comprising a proximal end portion defining a fixed passage, wherein the array of filaments is connected to the proximal end portion aligning the fixed passage and the passage.

86. (previously presented) An expandable cannula as set forth in claim 85 wherein the proximal end portion includes inner and an outer rings, wherein the array of filaments is clamped between the inner and outer rings.

87. (previously presented) An expandable cannula as set forth in claim 85 wherein the fixed passage has a cross sectional size substantially equal to the relatively large cross sectional size of the passage in the expanded condition.

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88. (previously presented) An expandable cannula as set forth in claim 66 wherein the array of filaments is made of a first material and the sheath is made of a second material different from the first material.

89. (canceled)

90. (previously presented) An expandable cannula as set forth in claim 72 wherein the variable volume chamber is disposed adjacent to one end portion of the sheath.

91. (previously presented) An expandable cannula as set forth in claim 90 further comprising a conduit enclosed by said sheath and extending along an inner side of said sheath to said variable volume chamber, the conduit being adapted to be connected in fluid communication with a source of fluid pressure to enable the conduit to conduct fluid pressure to the variable volume chamber.